



**CENTER FOR THE COMMERCIAL DEPLOYMENT
OF TRANSPORTATION TECHNOLOGIES (CCDoTT)**
California State University, Long Beach

April 12, 2010

Dr. Paul Rispin, Program Manager
Office of Naval Research, Code 333
875 North Randolph Street, Room 273
Arlington, VA 22203-1995

Re: CCDoTT FY08 Deliverable, Project 08-1, Task 1.2
Deliverable 1.2b – *FY 2008 Final Program Plan*

Dear Paul

A handwritten signature in black ink, appearing to read "Paul", written over the typed name "Paul" in the salutation.

In accordance with Contract N00014-09-C-0923, we are pleased to submit the above referenced deliverable.

The *FY 2008 Final Program Plan* (deliverable 1.2b) is final approved Statement of Work and Schedule of Payable Milestones included in our FY 2008 Agile Port and High Speed Ship Technologies program as approved by ONR.

This document is being submitted directly to the Defense Technical Information Center for public release approval.

Your comments on this document are appreciated.

Regards,

A handwritten signature in black ink, appearing to read "Stan", written over the typed name "Stan Wheatley".

Stan Wheatley
CCDoTT Principal Investigator



AGILE PORT AND HIGH SPEED SHIP TECHNOLOGIES

FY 2008 FINAL PROGRAM PLAN

Submitted to:

**Office of Naval Research
875 North Randolph Street, Room 273
Arlington, VA 22203-1995**

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**In fulfillment of the requirements for:
FY 2008 Contract No. N00014-09-C-0923
*Agile Port and High Speed Ship Technologies***

**FY08 Project 08-1
*Technical Coordination and Planning***

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**Prepared and submitted by:
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April 12, 2010

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AGILE PORT AND HIGH SPEED SHIP TECHNOLOGIES

FY 2008 FINAL PROGRAM PLAN

FY 08 Project 08-1, Program Element 6.08
Technical Coordination and Planning

Task 1.2 Program Development and Planning
CSULB Foundation Project No: 07-360808
Deliverable 1.2b

Submitted by:

Stan Wheatley, Managing Director
Center for the Commercial Deployment of Transportation Technologies
California State University, Long Beach

This material is based upon work supported by the Office of Naval Research, under Contract No.N00014-09-C-0923 with the California State University, Long Beach Foundation, Center for the Commercial Deployment of Transportation Technologies (CCDoTT).

Abstract

The Final Program Plan summarizes an 18 month stand-alone program under Contract Agreement N00014-09-C-0923 between the Office of Naval Research (ONR) and the California State University, Long Beach Foundation on behalf of the Center for the Commercial Deployment of Transportation Technologies (CCDoTT). The Plan provides and outline of the projects being conducted. Recent emphasis placed on technology transition has resulted in improved alignment of our program with Future Naval Concepts requirements, through increased two-way communication with the Navy, DoD and commercial decision makers, and increased communication with the stakeholders that hold the best promise of becoming end users of our projects.

This approach was very effective and has resulted in the series of high level interest Naval and dual use commercial/Naval projects that comprise this FY08 program. The program is based on priority projects requested by N-42, Strategic Sealift, that are time sensitive requirements relating to the evaluation of the “Sea Train” systems concept and the supporting projects related to Sea Train; American Marine Highway (AMH), High Speed Ship design tools and dual use of AMH ships for use as Ready Reserve Force (RRF) ships. It includes CCDoTT program support and a priority project supporting a technology demonstration related to logistical asset visibility.

Marine Highway/Short Sea Shipping projects initially focused on commercial shipping requirements relating to highway congestion and pollution. However, by making the specialized shipping dual use, rapid deployment requirements can be supported with a significant benefit of supporting the American shipbuilding industry. The merging of military and commercial is most clearly demonstrated in this FY08 Final Program Plan.

Agile Port and High Speed Ship Technologies**FY 2008 Final Program Plan****Table of Contents**

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Agile Port and High Speed Ship Technologies

FY 2008 Final Program Plan

1.0 INTRODUCTION

This summary document describes an 18 month stand-alone program under Contract Agreement N00014-09-C-0923 between the Office of Naval Research (ONR) and the California State University, Long Beach Foundation on behalf of the Center for the Commercial Deployment of Transportation Technologies (CCDoTT). CCDoTT is a partnership of academic and commercial research partners working together to focus on and develop related critical enabling technology. CCDoTT proposes to use a team of research partners to complement our in-house university capabilities and bring commercial operational experience to bear on selected Navy and commercial needs. Our years of experience organizing, planning, executing, and coordinating projects with partners who are acknowledged leaders in their respective fields brings credibility to the team and high probability of success to the projects. This Final Program Plan outlines the approved FY08 projects under this Agreement.

Last year's program, Fiscal Year 2007 funding, was focused on pushing ongoing multi-year projects to completion. Funding was limited and it was important to complete these projects in order to free Fiscal Year 2008 funding to focus on new projects relating to a host of exciting emerging Naval concepts. Additionally, there was more emphasis placed on the Technology Transition Project in order to further align our program with Future Naval Concepts requirements, maintain increased two-way communication with Navy, DoD and commercial decision makers, and increase communication with the stakeholders that hold the best promise of becoming end users of our projects. This approach was very effective and has resulted in the series of high level interest Naval and dual use commercial/Naval projects included in the FY08 program.

The FY08 program focuses on priority projects requested by N-42, Strategic Sealift, that are time sensitive requirements relating to the evaluation of the "Sea Train" systems and the supporting projects related to Sea Train, American Marine Highway (AMH) and dual use of AMH ships for use as Ready Reserve Force (RRF). It includes CCDoTT program support and a priority project supporting a technology demonstration related to logistical asset visibility.

All of the current selected projects are transportation related focusing on ships capable of dual use military and commercial cargo missions, how best to use those ships in the current cargo movement environment, potential use as RRF alternative and systems that support the cargo movement process. The projects fit into the evolving strategies of Seabasing, commercial short sea shipping, technological and environmental advances in cargo movement. We will continue to work on the technology advances provided by efficient design tools supporting the development of multihull vessels (such as the trimaran) and adapted to the constrained slender hull requirements of high speed ship designs.

Center for the Commercial Deployment of Transportation Technologies

Following in this section is a summary of the High Speed Ship, Agile Port Technologies, and Marine Highway/Short Sea Shipping projects proposed for the Priority and FY08 program. We use these distinct categories for organizational categories although some of the projects clearly contribute to development in more than one category. The emerging High Speed Ship systems and the Agile Ports and Terminals that support them represent an area of maritime technology development that has exceptional potential in advancing the national military and commercial transportation capability. High-speed movement of commercial cargo improves the national competitive edge in a highly competitive domestic and international industry. Agile Ports sustain that increased speed of movement by reducing the port flow-through time (and therefore cost) while impacting almost every aspect of port operations including intermodal transfer, land requirements, traffic, pollution, labor, security, and information technology requirements. Agile Ports and Terminals technologies are inclusive of military logistics operations as is the case with the current submission. For that reason, we have not categorized specific projects as Rapid Deployment Technologies or focused purely on a military requirement. Marine Highway/Short Sea Shipping projects initially focused on commercial shipping requirements relating to highway congestion and pollution. However, by making the specialized shipping dual use, rapid deployment requirements can be supported with a significant benefit of supporting the American shipbuilding industry. The merging of military and commercial is most clearly demonstrated in this area.

Section 2.0 provides the Statement of Work for all the proposed projects and organizes them based on the party responsible for project coordination, either CCDoTT/CSULB (Part I) or a Research Partner (Part II). Section 3.0 is a chronological summary of FY08 payable milestones. This is followed by FY08 deliverables for each of the projects (Section 4.0), and Summary and Conclusions (Section 5.0).

1.1 CCDoTT:

The CCDoTT portion includes three projects that support the total program providing critical multi-project coordination and technology transition functions.

- *Technical Coordination and Planning* insures integration and coordination of projects on the single, multiyear, and inter-project level to provide continuity of program and Sponsor objectives. Program and project monthly and quarterly reports provide the status of the program and individual projects to the ONR Program Manager and end-of-program summary reporting. Initial and End-of-Year program planning provides direction and continuity.
- *Technology Transition and Outreach* provides the critical effort to align essential stakeholders to support projects and find end users to exploit the technology capabilities developed by the projects. Technology transition activities are accomplished through a variety of methods such as: hosting regional conferences and meetings, conducting technical interchange meetings with CCDoTT's Advisory Board, giving presentations to stakeholders and potential end users, making presentations to professional organizations, maintaining a website with current and past project results, and publicizing new technologies through the press and periodical publications.

In addition to the established Technology Transition and Outreach methods, we have added another element as a self-contained project. The additional project provides more specific focus on elements of the Technology Transition process and intensifies the effort to find the most critical needs of our “customers.”

- **CCDoTT Technology Transition Support Project** - The objective of this process would be to ensure that CCDoTT is sensing the evolving commercial and military needs, is pursuing projects that respond to these needs, and is adequately promulgating the results of projects so that maximum benefits can be reaped. The result will be to refine the process so that end users are fully integrated into the Technology Transition process from beginning to end.

The projects submitted in this program are a direct result of the Technology Transition effort initiated in the FY07 program. Through extensive work with military and commercial agencies the commonality of the systems has been identified and the potential for dual use ships recognized as a very real objective.

1.2 High Speed Ship (HSS) Technologies:

Past CCDoTT projects have contributed to the development of multi-hull ships, and specifically the trimaran, as viable high speed hull forms. High speed ships require new and innovative hull designs and powering systems. The FY08 program includes two (2) projects that will allow us to press forward in this area. We focus our High Speed Ship development in ways that directly impact mid-term high speed ship capabilities and take full advantage of the experience we have gained in this area. The evaluation of Sea Train Technology is being done at the request of the Navy, Strategic Sealift (N-42). CCDoTT multi-year work on multi-hull design tools will support the more detailed evaluation of emerging Sea Train technologies

- *Sea Train Technology High Level Engineering Comparative Evaluation:* This new project proposes to conduct a high level engineering evaluation of all the current SeaTrain concepts and enabling technologies and recommend a technology development program. This would entail assessment of their strengths and weaknesses, evaluation of the risks, estimation of the operating and capital costs, and ranking the concepts for both military missions and commercial cargo ship application.
- *Computational Tools Development of Evaluation of Sea Train Concepts: Model Building and Initial Parametric Analysis:* This new program builds upon the extensive experience of CCDoTT in the areas of multidisciplinary design and optimization (MDO) computational tools, as well as our pioneering developments of systematic calculation series (SCS) and neural networks-based response-surface methods (RSM), to apply them to the development of practical comprehensive computational tools for evaluation and optimization of Sea Train concepts.

1.3 Agile Port (AP) Technologies:

Agile Port technology exploits technological innovation, information technology and the restructuring of infrastructure and processes to increase cargo throughput and overall terminal productivity at our ports. The definition includes all cargo movement facilities and means at the port. Concepts now include supporting operations such as intermodal facilities, inland intermodal and transshipment facilities, inland port concepts, and innovative new technologies for transporting cargo. Military cargo movement is dependent on commercial capabilities, and improvements that increase throughput in the commercial sector directly support timely military surge and sustainment requirements while simultaneously deconflicting the interruption of commercial movement. CCDoTT has been at the forefront of Agile Ports since developing the *High Speed Sealift/Agile Port Operational Concept Document* for the United States Transportation Command in 1995.

There is one (1) project that comprises the AP effort for the Priority and FY08 program:

- *Real Time Location System (RTLS) Multi Angle Sensor Demonstration:* This project serves both the military and commercial interest by providing an innovative and differentiated technology to solve the problem of accurately pinpointing the location of objects in real-time. This goes beyond knowing that an object has “arrived” or “departed” an area, but knowing where the object is located within an area. The ability to generate accurate location in a large area with a small quantity of readers placed around the perimeter would effectively serve military logistician setting up temporary operational logistics sites by providing the means to pinpoint locations for items. Locating objects within an area helps to reduce item loss, inefficient storage and retrieval activities, and costly project delays, thereby reducing the need to overstock to prevent such losses.

1.4 Marine Highways/Short Sea Shipping:

The American Marine Highways is a term used in recent legislation to describe Short Sea Shipping: the use of coastal and inland waterway shipping to take cargo off American highways to reduce congestion and pollution. CCDoTT saw the potential of this approach in the mid 1990's with economic feasibility studies and commercial multi-hull and high-speed ship designs. Environmental and congestion demands have increased interest in this area. Reflected in this Plan is the emerging recognition of the huge potential to American shipbuilding represented in this expanding industry, and the dual use value of this class of ships to the military.

There are two (2) projects that comprise the SSS effort for the FY08 program:

- *Marine Highways System Evaluation Model:* The objective of this project is to develop a generalized discrete event and voyage model and an economic model that will serve as decision support tools to conduct “what-if” analyses, evaluate infrastructure requirements, and assess the economics for markets of interest and alternative business models. This model will serve as a starting point for future studies and will be evaluated against select test markets. Current efforts will be to develop a rational procedure, evaluation methodology, and tool for providing guidance to the maritime community to

evaluate U.S. Maritime Highways. The simulation tool/program will be verified and benchmarked against selected East Coast routes and markets.

- *Multi-purpose American Marine Highways Series Production Ship:* This project also relates to the Short Sea Shipping concepts with a focus on the commercial development that will ultimately be incorporated with the dual use military requirements. The effort focuses on two areas. The first is to develop a flexible, utilitarian, easy to build AMH transport vessel. The second is to develop a cargo handling system for trailers, domestic intermodal and international freight containers that is both simple and inexpensive when compared to the current conventional cargo handling systems. Both efforts will lead to concept level designs that identify the major characteristics of the design and describe the major features, advantages and possible disadvantages of the concept.

2.0 CCDoTT FY08 STATEMENT OF WORK SUMMARY

The following program has been selected for FY08 program. All projects cover an 18 month time period.

Part I efforts are those to be accomplished directly by CCDoTT and California State University, Long Beach. These efforts include project oversight and the technology transition process to facilitate the dual use military/commercial coordination and the critical development and handoff of ready for exploitation technology to viable end users. Research partners from the University, other universities, government agencies, the military and commercial entities may be included in these efforts.

Part II involves efforts where the advanced technology development being pursued is not resident at the University. Research partners at the cutting edge of the critical technologies are tasked to develop necessary technologies to support the overall CCDoTT objectives with oversight and overall project integration performed by CCDoTT. Other University and research partner projects will be considered, budget allowing.

2.1. Project List

No.	Organization	Title	Area	Estimate
UNIVERSITY RESEARCH PROJECTS				
08-1	CSULB/CCDoTT	Technical Coordination and Planning	PM	\$359,023
08-2	CSULB/CCDoTT, Herbert Engineering	Technology Transition and Outreach - Includes: • CCDoTT Technology Transition Support Project	PM	\$773,999
08-4	CSULB/COE, CSC	Computational Tools Development of Evaluation of Sea Train Concepts: Model Building and Initial Parametric Analysis	HSS	\$484,007
COMMERCIAL RESEARCH PARTNER PROJECTS				
08-3	TruePoint Systems	Real Time Location System (RTLS) Multi Angle Sensor Demonstration	AP	\$172,458
08-5	Herbert Engineering	Sea Train Technology High Level Engineering Comparative Evaluation	HSS	\$415,210
08-6	CDI Marine	Marine Highways System Evaluation Model	MH	\$229,993
08-7	Herbert Engineering	Multi-purpose American Marine Highways Series Production Ship	MH	\$176,981
ONR Contract N00014-09-C-0923				\$2,611,671
TOTAL FY08 AP/HSS Technologies Program				\$2,611,671

AGILE PORT AND HIGH SPEED SHIP TECHNOLOGIES**STATEMENT OF WORK****PART I****CALIFORNIA STATE UNIVERSITY, LONG BEACH**

No.	University Project	Title
08-1	CSULBF/CCDoTT	Technical Coordination and Planning
08-2	CSULBF/CCDoTT	Technology Transition and Outreach
08-4	CSULB/COE – Hefazi	Computational Tools Development of Evaluation of Sea Train Concepts: Model Building and Initial Parametric Analysis

Project 08-1: Technical Coordination and Planning

University Project: CSULB Foundation, CCDoTT

Co-PI: Stanley Wheatley

Program Sector: Covers all sectors

This project identifies and coordinates diverse technological advancements from an extended set of research partners within CSULB, academia, governmental agencies and commercial ventures. CCDoTT intends to use its assets to validate research findings and coordinate them into a focused program of action for the advancement and dissemination of transportation technologies.

Project activities include all technical, managerial, and coordination efforts required to ensure the efficient and effective performance of the current and out-year CCDoTT projects. This includes: ensuring quality performance and timely completion within budget for all project tasks; establishing a framework for the following year's activities to advance technological capabilities; and incorporating end user participation into the program development in order to ensure a high probability of eventual operational implementation. Deliverables on this project will consist of reporting requirements as set forth in the contractual agreement.

Project 08-1 Tasks are as follows:

- 1.1. FY08 Project Oversight: This task encompasses all activities required to ensure the efficient and effective performance of current year CCDoTT projects. Specific activities include: development of a Current Year Program Plan, performing technical oversight and evaluation of all milestones and deliverables on each project; collaboration with research partners to develop appropriate corrective actions on each project milestone or deliverable by CCDoTT technical review experts; conducting Interim Project Reviews with all projects on a routine basis; interface with ONR Project Manager and designated Subject Matter Experts; review and coordinate proposed Project modifications.
- 1.2. Program Development and Planning: This task encompasses maintaining the continuity of past and current projects and the development of potential out-year projects. Specific activities include: assessing future program potential of current projects; evaluating technological innovations and their dual-use potential; coordinating inter-partner actions in support of projects; coordinating model/simulation development to support multiple projects; strategic planning to ensure continuity of ongoing/multi-year projects and coordination of long range goals into an End Year Program Plan; identifying and prioritizing projects for selection in the next fiscal cycle (FY09) through the End Year Program Plan; interface and coordinate the recommendations of the CCDoTT Advisory Committee linking planning and Technology Transition functions.

Project 08-2: Technology Transition and Outreach

University Project: CSULB Foundation, CCDoTT

Subrecipient: Herbert Engineering

Co-PI: Steven Hinds

Program Sector: Covers all sectors

A strong argument can be made that says Technology Transition is the most important project in the CCDoTT program. This position has evolved over 12 years of program development and management that invariably leads back to the stark reality that if no one gets or uses the information, processes, tools, technology, etc. that we produce, not much is truly accomplished. We have, therefore, gone to great efforts to develop approaches for disseminating the results of the CCDoTT Program. An examination of the CCDoTT list of Technology Transition tools and those used in the Naval Shipbuilding Research Program are consistent and demonstrate the focus on the effort to pass on information with the objective of increasing general awareness, profound knowledge, and/or ability to implement results.

This project recognizes that Technology Transition success requires more than the standard outreach processes that are the foundation of our current approach. The transmission of new ideas, technologies and concepts requires an aggressive multi-directional approach that not only pushes the information out, but, implements an equally aggressive feedback process. That process concentrates on stakeholder response to CCDoTT project results and seeks information to support future project selections – projects that meet the requirements of the commercial and military stakeholders and ultimately the end users of the R&D effort.

A third aspect is that technology transition is much more easily accepted by a known and validated technology source. In FY07 a concerted effort began to focus on assisting many of CCDoTT's long-term projects with transition efforts. This led to success identifying the following stakeholder needs:

- a) OpNav N42 Strategic Mobility and Combat Logistics need for an objective evaluation of SeaTrain technology
- b) NavSea and NSWC-Carverock need for an advanced set of ship design evaluation tools
- c) The US Army Headquarters' need for enhanced analytical capability to support advanced high speed sealift and anti-access austere port challenges
- d) US Army's need for high speed ship technology development
- e) America's emerging new Marine Highway system requirement for an integrated AMH transportation system design "from inter-state off ramp to inter-state on ramp".
- f) SNAME's need for an economic model of ocean transportation systems "from factory to ship to upland distribution center of big box store"
- g) SNAME's need for an active R&D center as a partner for alternative energy as well as transportation research and development
- h) The National Shipbuilding Research Program's need to balance its predominantly Navy orientation with some commercial shipbuilding market R&D
- i) The Maritime Administration's need for AMH technical knowledge and R&D management capability

- j) The Transportation Research Board's need for R&D to support AMH through their ferry committee AMH Subcommittee

Specific projects were created and proposed for the CCDoTT FY08/09 program to meet the (a) through (f) and (h) & (i) needs above, and a proposal was sent to the TRB on calculating the cost of congestion for item (j) above. Considerable effort was devoted to item (h) in FY07 which resulted in a very successful NSRP AMH workshop. CCDoTT is now a member of the TRB Ferry committee and in MarAd a member of the Marine Highway Cooperative (MHC) and the Concept Design Working Group (CDWG).

This proposed Technology Transition project will maintain the previous foundation tasks outlined below that have been successful in the past.

Project 08-2 Tasks are as follows:

- 2.1. Planning, Evaluation and Recommendations for the Future: The Technology Transition planning process includes an aggressive search for stakeholders and potential end-users, multi-year coordination of ongoing and potential projects, evaluation of technologies from a transition perspective, research into new technologies and determination of their transition potential.
- 2.2. Meetings, Conferences and Presentations: CCDoTT shall hold Technology Transition events for the public and/or invited guests. CCDoTT will host two major conferences: one on the East Coast providing the opportunity to brief partners, academia, military and government representatives; and another on the West Coast specifically designed for outreach activities within the local transportation community. Meetings with CCDoTT's Advisory Board are held in conjunction with these events and on an as needed basis for feedback and guidance. CCDoTT staff will aggressively pursue transition efforts on long-term projects which have matured under the program. This will include coordination of meetings and events to present CCDoTT technologies to other organizations and potential customers.
- 2.3. Information Dissemination/Publications: This task consists of the public distribution of current and past project results, publication of other CCDoTT material necessary for the success of Technology Transition activities, special reports as requested, and maintaining a public website with research results. This tangible information is critical to the effective communication of ideas to Sponsors and prospective end users when discussing the concepts and potential viability of CCDoTT projects.
- 2.4. Technology Transition Support Project: This project offers a formal process directed toward the goals of increased visibility of CCDoTT success and generation of a network of research, stakeholder and end user partners. It includes developing the details of a program to define technical needs, find partner/end users, actively promulgate project results, solicit endorsements and new projects from successfully served "customers" and develop new customers from a "network" of transportation and maritime operators. This network includes land transportation operators including trucking firms and railroads as well as

commercial ship owners, shipyards, port and terminal owner/operators, government maritime logistics, security and military agencies, command and control system developers and suppliers and other private and public entities in the transportation business. The objective of this process is to ensure that CCDoTT is sensing the evolving needs in both government and industry, is pursuing projects that respond to these needs, and is adequately promulgating the results of these projects so that the greatest benefit can be reaped. The goal is to expand the user base and identify vital new research projects.

Project 08-4: Computational Tools Development of Evaluation of Sea Train Concepts: Model Building and Initial Parametric Analysis

University Project: CSULB College of Engineering

Sub Recipient: CSC Advanced Marine Center

Project Co-PI: Dr. Hamid Hefazi

Program Sector: High Speed Ship Systems

This new program builds upon the extensive experience of CCDoTT in the areas of multidisciplinary design and optimization (MDO) computational tools, as well as our pioneering developments of systematic calculation series (SCS) and neural networks-based response-surface methods (RSM), to apply them to the development of practical comprehensive computational tools for evaluation and optimization of Sea Train concepts.

This first phase will focus on the development of the scientific background and knowledge database that is needed to assess the difficult hydrodynamic interaction problems of this innovative concept. Various state-of-the-art computational tools will be used to evaluate selected Sea Train technologies, perform a series of seakeeping, hydrodynamic loads, and maneuvering calculations, and initiate the extension of CCDoTT's pioneering approaches in building systematic calculation series and neural network-based response surface models. This study will provide the basis for the development of comprehensive, practical computational MDO tools for Sea Train concepts in the future phases of this program.

Background:

During the past several years a team consisting of CSULB faculty and students and CSC researchers has worked on a number of programs to develop advanced multi-objective design and optimization computational tools. Computational design tools can be prohibitively expensive, considering the complexities that are involved in accurate analysis of various subsystem performances such as powering, structural loads, seakeeping, etc. Optimization of such concepts poses even greater challenges since it requires large numbers of such subsystem evaluations. To address these challenges, we have created a single design and optimization tool that integrates multi-objective optimization methods in conjunction with an innovative approach of using advanced CFD computations through artificial neural networks to accurately and efficiently predict powering, performance, seakeeping, and structural loads. This pioneering approach removes the computational cost of CFD methods from the optimization loop and shifts them to the generation of (smaller) training sets for neural networks. Therefore, the approach allows the use of high-fidelity CFD calculations even in the early stages of the design process. The method has been successfully applied to a number of multihull (JHSV and JHSS trimaran and catamaran) concepts. Design of other innovative concepts, where little-to-no previous data or experience exists, can equally benefit from such advanced MDO development.

Sea Train is a potentially valuable concept for the Army Sealift, the Marine Corps as well as a broad spectrum of commercial marine transportation applications. At the present, five concepts are being developed in the U.S. under different funding sources. All these projects have included scale model tests to evaluate the hydrodynamic features of the concepts. A separate FY08

AP/HSS project (08-5) “Sea Train Technology High Level Engineering Comparative Evaluation” will conduct a relatively short term comparative evaluation of the five Sea Train concepts. Development of the computational tools will support this evaluation and ongoing more detailed evaluation beyond the high-level effort.

Hydrodynamic tests have confirmed such basic Sea Train expectations as resistance advantages in comparison with displacement-equivalent conventional monohull ships. However, since Sea Train is a highly innovative concept, no reliable design statistics or methods are available. Physics-based evaluation and design processes, and corresponding tools, are therefore needed. These tools enhance the ability of the designer to balance various technical issues and cost, fully explore the design space relative to a specific requirement, and efficiently assess feasibility of various potential designs, thereby reducing program risks.

Some of the main technical challenges that are specific to the Sea Train concepts are resistance prediction, with consideration of multi-body wave interference, maneuverability and motion and loads, and also with consideration of multi-body interference issues. Resistance of multi-body problems has been studied experimentally and with CFD tools but mostly in the context of multi-hull ships. While the current Sea Train programs have produced some (as yet unpublished) results specific to Sea Trains, the need to develop an accurate, robust computational method that is applicable to the Sea Train concept is essential. Such a computational tool would allow the designers to efficiently assess a design and explore the effects of key parameters, such as the number of hulls and their sizes, on the performance of the Sea Train.

Assessment of the seakeeping or maneuvering of the Sea Train concept also involves multiple vessels that are responding to waves in close proximity. The motion of each vessel generates waves that propagate out away from it which will impact neighboring hulls. In addition, the presence of additional hulls changes the ambient wave field in that some vessels or portions of vessels will be shielded from some of the wave energy by being in the wave shadow of the other vessel. Therefore, a seakeeping code that is capable of modeling multi-body radiation and diffraction is required. Some of the Sea Train concepts are for multi-hulls so the analysis tools must include the ability to model multi-hulled vessels. Additionally, the connections between elements of the Sea Train are inherently nonlinear.

Most of the commercially available computational seakeeping tools are limited to single-body applications. While some computational tools for multi-body motion and loads prediction are available, their application to the Sea Train concept needs additional development. This is one of the main focuses of this project. The multi-body variant of WADAM will be used for this task. WADAM is a linear theory code that has been used successfully to model the motions of multiple vessels in waves including radiation and diffraction effects. However, it has some limited capability for including physical vessel-to-vessel interactions and the effect of connectors such as mooring lines and fenders. WADAM response amplitude operators (RAOs) have been successfully imported into another program called Orcaflex to produce time series motions that included nonlinear body-to-body and spring interactions between multiple vessels with realistic connections. The body-to-body contact is actually very difficult to model in most programs, but Orcaflex does an excellent job. CSC has over seven years experience with Orcaflex and is very confident that this tool, combined with the WADAM RAOs, can produce a wide range of

accurate results including graphic movies of the motions. The Orcaflex software's ability to couple linear RAO-based seakeeping with nonlinear time domain interaction forces, winds, currents and maneuvering is very powerful and can produce reliable data for assessment and evaluation of Sea Train design concepts.

Technical Approach:

The work proposed will lead to the development of computational methods to predict the resistance, seakeeping and maneuvering capabilities of the Sea Train concept across the multi-variant parametric space. The overall technical approach is to use a database of design-specific behaviors, systematic calculation series and neural network-based response-surface models to make these predictions robust and practical. These computational tools can then be integrated into a multidisciplinary design and optimization (MDO) method to perform tradeoff design of experiment and optimization studies for various requirements. The technical approaches for accomplishing these goals are described below for three phases of the program.

FY08 efforts will build the models and perform initial parametric analysis. This includes the review of existing technologies including tug and barge combos in the US and Europe, developing a run matrix that covers the range of desired parameters within the scope of effort desired, and modeling each of the modules for the chosen Sea Train concept. The computational tools used include Star CCM+ or Fluent for resistance prediction, CSC's Multi-Vessel Simulator (MVS) or Virtual Ship for the maneuvering assessment, a multi-body version of the DNV Software WADAM code and Orcaflex software from Orcina. Additionally, CSULB's pioneering neural networks programs will also be utilized for RSM. All of these tools have to be adapted for multi-body applications in the context of the Sea Train.

For motion analysis, the approach is to perform one or two analyses for each type of module to ensure that the results are credible and that there are no errors in the input files. The next step is to perform a simple hydrostatics study using GHS for each hull form to make sure that the draft, displacement, etc used for input are reasonable. Then model one initial setup of the Sea Train at several headings, one speed and a single sea state to get the model working correctly. Finally, examine the output data.

From the output data, develop a modeling plan for the long-term (outyear) analysis. The long-term objective is to use these results to develop complete neural network-based RSMs and integrate them into a comprehensive MDO tool. An important ancillary result of this work, based on seakeeping and maneuvering limitations, will be the development of a safe operating envelope for each Sea Train concept chosen.

Project 08-4 Tasks are as follows:

- 4.1. Resistance Modeling and Assessment: Assessment of advanced CFD methods and model test data, to predict the resistance of Sea Train concepts. Basic systematic calculation series for the resistance of a generic Sea Train configuration will be conducted with focus on parameters such as size and number of hulls.

- 4.2. Maneuvering Assessment: Develop response surface modeling, geometry and graphical visualization tools to assess maneuverability.
- 4.3. Motions and Connector Loads: Modeling the behavior and interactions of the Sea Train modules while underway and maneuvering in a seaway.
- 4.4. Validations and Application: Validation of the computational results by comparing them with available model test data and their application to selected requirements as identified under a separate AP/HSS project, “Sea Train Technology High Level Engineering Comparative Evaluation” (08-5).
- 4.5. Final Report: Report describing a Technology development plan, including methodologies and calculation results in the area of seakeeping and maneuverability as a necessary knowledge database for Sea Train evaluation studies. Additional results for preliminary resistance and neural-network based response surface models and optimization studies. The report will also describe a technology development plan for multidisciplinary optimization (MDO) tools, for the assessment, evaluation, and optimization of innovative Sea Train concepts

AGILE PORT AND HIGH SPEED SHIP TECHNOLOGIES**STATEMENT OF WORK****PART II****RESEARCH PARTNERS / SUB RECIPIENTS**

No.	Research Partner/ Sub Recipient	Title
08-3	TruePoint Systems	Real Time Location System (RTLS) Multi Angle Sensor Demonstration
08-5	Herbert Engineering	Sea Train Technology High Level Engineering Comparative Evaluation
08-6	CDI Marine	Marine Highways System Evaluation Model
08-7	Herbert Engineering	Multi-purpose American Marine Highways Series Production Ship

Project 08-3: Real Time Location System (RTLS) Multi Angle Sensor Demonstration

Research Partner: TruePoint Systems

CSULB Co-PI: Steven Hinds

Technical Director: Anne Yee

Program Sector: Agile Port and Terminal Systems

TruePoint Systems has been working with outside investors and in partnership with CSULB to develop its innovative and differentiated technology to solve the problem of accurately pinpointing the location of objects in real-time. This goes beyond knowing that an object has “arrived” or “departed” an area, but knowing where the object is located within an area. Locating objects within an area helps to reduce item loss, inefficient storage and retrieval activities, and costly project delays, thereby reducing the need to overstock to prevent such losses.

This technology specializes in meeting market needs that demand accurate location with quick set up time and minimal infrastructure. TruePoint’s patent pending solution leverages beamforming and phased array antennas along with intelligent and statistics based algorithms at the system level to generate accurate location in a large area with a small quantity of readers placed around the perimeter.

The potential customers of this technology may be both commercial and/or military. The radio frequency (RF) transmitters that are located may be attached to objects such as pallets, shipping containers or the actual goods themselves in an indoor or outdoor, structured or unstructured warehouse. This is particularly useful in ad hoc or temporary storage facilities in which large size areas must quickly be converted into efficient storage areas such as for Federal Emergency Management Agency (FEMA) emergencies. In other applications, the RF transmitters may be attached to important objects that need to be tracked in expansive outdoor construction sites such as for oil, gas, and electricity development. Additional applications include outdoor storage and staging areas like ports or overflow storage areas in large depots, as well as rapid goods movement like pallets that come in on one dock, get repackaged and go out via trucks on another dock. Essentially, the solution can be effective in any environment where there is a need to track objects that may be stationary at times and may move from time to time and where infrastructure is minimized over a sizable area.

The market has been assessed to find similar solutions that offer similar benefits. While there are other real time location system (RTLS) solutions on the market, none have applied the same combinations of technology and architecture to achieve the real environment accuracy over a large coverage area affordably with minimal infrastructure.

Out year efforts would progress to a multi-transmitter capability and then to full scale pilot. Design issues that are pilot specific, such as transmitter form factor to support different attachment mechanisms to different objects (e.g. metal vehicle vs. wooden pallet) would be addressed in the pilot.

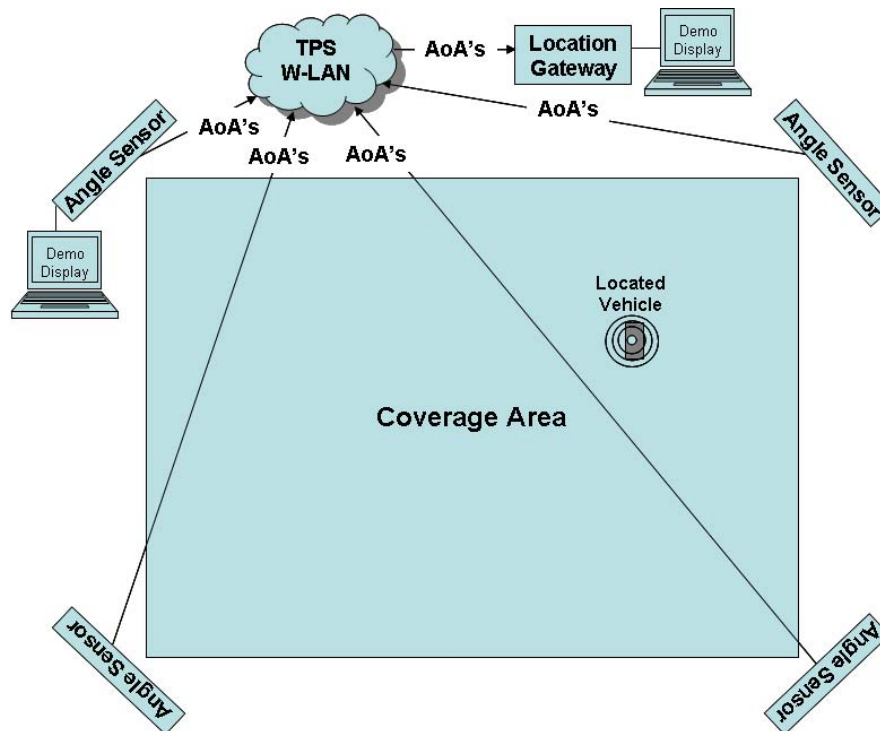
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This Multi Angle Sensor Demonstration will prove the ability to locate an item using at least three and up to four angle sensors by developing an outdoor parking lot environment demonstration capability, collecting data in that environment using the capability, and then analyzing the data to assess the location performance.

The RTLS uses phased array/beamforming based angle sensors as “readers” to detect the angle of arrival of a transmitted signal. With multiple angle sensors, the RTLS determines the X,Y location of the signal transmitter. Multipath issues are resolved and overall accuracy is improved by employing statistical and heuristic based techniques at the X,Y level.

X,Y algorithms can currently be demonstrated using simulated inputs and a full hardware prototype of a single angle sensor has been built to prove the ability to detect angle of arrival. The next step towards commercialization is to be able to demonstrate the X,Y algorithms with multiple angle sensors, each independently detecting the angle of arrival of the transmitted signal. The purpose of this project is to complete the multi angle sensor demonstration.

The graphic below illustrates the demonstration configuration planned.



Note: Currently the plan is to build and use four angle sensors around a rectangular coverage area as shown in the figure above. If, due to long lead item parts or parts failure, all four are not available at any point in time; the capability could also be demonstrated using only three angle sensors.

The scope of technical work necessary to achieve the demonstration encompasses: (a) procuring hardware, (b) enhancing software, (c) performing hardware/software integration and testing, (b) conducting location demonstrations, (c) collecting performance data and (d) reporting on the demonstrated performance.

The benefit of this project is to achieve a major step towards commercialization of the RTLS technology. Organizations interested in the solution need to know that the technical risks have been resolved and the path towards first pilot is quick and manageable. A full system demonstration will provide that kind of assurance to prospective users and other interested parties

Project 08-3 Task is as follows:

- 3.1. Conduct Multi Angle Sensor Demonstration and Final Report: Prepare for and conduct a demonstration to prove the location capability of the system and generate a Final Report.

Project 08-5: Sea Train Technology High Level Engineering Comparative Evaluation

Research Partner: Herbert Engineering Corporation

Sub Recipient: SPAR Associates, Inc.

CSULB Co-PI: Steven Hinds

Technical Director: Rick Thorpe

Program Sector: High Speed Ship Systems

This new project proposes to conduct a high level engineering evaluation of all the current SeaTrain concepts and enabling technologies and recommend a technology development program. This would entail assessment of their strengths and weaknesses, evaluation of the risks, estimation of the operating and capital costs, and ranking the concepts for both military missions and commercial cargo ship application.

The primary objective of the SeaTrain technologies currently being developed in the United States is to enable relatively short vessels to operate at the higher speeds that longer ships achieve by linking shorter units together to form a long, slender vessel configuration. Once in the port area the individual units can be separated to access one or more austere ports. This has advantages for both military and commercial cargo operation applications. In addition to being relatively short, each hull unit also can be designed to be relatively shallow draft further enhancing its austere port capability.

Currently in the USA five different SeaTrain concepts are being developed under Small Business Innovation Research (SBIR) or advanced vessel development projects which have or will include scale model tests to evaluate their hydrodynamic features. These projects are:

- Alion/Keck Technologies SES technology
- Art Anderson Associates Trimaran Technology
- Maritime Applied Research Corporation Monohull Technology
- NSWCD Monohull Technology
- MechMath Cavity Drag Reduction SeaTrain

The above technologies have been developed by different types of firms including a high tech prototyping company, two Level of Effort (LOE) naval architectural firms, a private advanced technology professional and a Navy Laboratory. The business capabilities of these firms also needs to be evaluated along with the basic concepts and enabling technologies.

Considerable US Government and private industry money has been spent on SeaTrain technology development. The resulting development has reached a point where it is or can be proposed to Naval Operations' Strategic Mobility and Combat Logistics Division (N42) to meet military logistics requirements and to the American Marine Highways Industry for application to national short sea shipping needs for relatively high speed shipment of cargo.

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Specifically, N42 has expressed the need to sort through these various SeaTrain technology offerings by conducting a high level engineering evaluation to determine the strengths and weaknesses, opportunities for useful application and technical and operational risks associated with each concept. Such an evaluation could help focus on the most promising concepts and lead to a comprehensive development program.

The outcome of such an evaluation would be the determination of the technical attributes, assessment of the technology risks, and estimates of the relative capital and operating costs, overall commercial viability and military utility of each concept. Two additional major outcomes would be recommendations for a comprehensive development program and a ranking of the technologies as military logistics ocean transportation systems.

The general methodology of this project is to organize a group of senior technical professionals to review and analyze the wide range of SeaTrain data which will be made available from the Navy and from the five SeaTrain developers. The group is a balanced mix of enabling technology expert consultants, engineers and naval architects with both naval ship and commercial vessel design, construction, testing and operations experience. All team members have solid engineering backgrounds and ship design experience. These professionals will produce the questionnaires, technical attributes, Technical Readiness Level reports, Technology Development recommendations and outline planning and other deliverables.

A companion AP/HSS project (08-4) “Computational Tools Development of Evaluation of Sea Train Concepts” will run in parallel with this project. This is a comprehensive SeaTrain evaluation concentrating on seakeeping and maneuverability issues using the powerful ship design tools developed by CCDoTT complimented with seakeeping and maneuverability analysis. Results of this project will feed into this High Level Engineering Comparison Evaluation.

The primary end user will be Naval Operations Strategic Mobility and Combat Logistics Division (N42). Other end users with interest are the US Army (Headquarters), NavSea’s Sealift and Auxiliary Ship Project Management Organization (PMS385), the Department of Transportation and the Maritime Administration for America’s Marine Highway (AMH) oversight, and potential corporations and individuals in AMH industry who have interest.

Project 08-5 Tasks are as follows:

- 5.1. Prepare a Project Plan Of Action (POA): Prepare project operation guidelines, contact and brief the contenders and collect and organize the available data, mostly as provided by the Navy.
- 5.2. Prepare Evaluation Comparison Matrices: Categorize this information in matrices of potential users, concept general attributes, enabling technologies and other reports.
- 5.3. Prepare and Issue Questionnaires: Prepare a questionnaire to solicit more detail information from all five seatrain concept developers.

- 5.4. Prepare Technical Attributes by Contender: Evaluate the information provided in the answers to the questionnaires and write a technical report on the technical attributes of each seattrain concept as applied to both commercial and military roles.
- 5.5. Prepare Technical Readiness Level Analysis: Conduct a Technical Readiness Level (TRL) risk analysis of both the seattrain enabling technologies and separately the concepts; and then write a TRL report.
- 5.6. Prepare Cost Analysis: Cost analysis of each concept configured for each of their appropriate applications can then be made including the cost of the risks identified in Task 5.5.
- 5.7. Draft Risk and Cost Reports: A draft of the results of Task 5.6 above is provided to each contender of their system only, for review and comment as Task 5.7.
- 5.8. Final Risk and Cost Reports: After receipt of the comments any conflicts are resolved and a Risk and Cost Report is prepared for each contender as the deliverable of Task 5.8.
- 5.9. Prepare Best in Class Report: Rank the contender concepts and select promising candidates by user/mission categories and prepare a Best in Class report.
- 5.10. Prepare Final Seattrain Evaluation Report and Presentation: After preparing a presentation and giving it to stakeholders (primarily N42 but also PMS385, the Army and commercial parties) a final Selection report is written.
- 5.11. Seattrain R&D Program Recommendations: Enabling technology risk factors of the final selection are used to identify, define and recommend further development work. This is used to prepare recommendations with an outline seattrain R&D program.

Project 08-6: Marine Highways System Evaluation Model

Research Partner: CDI Marine Company

CSULB Co-PI: Steven Hinds

Technical Director: Dan Bagnell

Program Sector: Marine Highways/Short Sea Shipping

The objective of this project is to develop a generalized discrete event and voyage model and an economic model that will serve as decision support tools to conduct “what-if” analyses, evaluate infrastructure requirements, and assess the economics for markets of interest and alternative business models. This model will serve as a starting point for future studies and will be evaluated against select test markets.

It is also the intent of this study to engage other interested organizations such as the SNAME Panel O-36. This work will be supportive of SNAME Panel O-36’s “Task Statement for Economic Modeling Effort” that presented a vision for a comprehensive, modular, and user-friendly model. Additional key stakeholders for this project include MARAD and the Navy (N42). MARAD has an interest in decision support tools to assist in evaluating proposed Marine Highways corridors and potential Marine Highways projects. N42 has an interest in understanding the potential impact of militarily useful features on Marine Highways operations and the opportunities to leverage Marine Highways vessels to support sealift objectives. Together with CCDoTT, SNAME Panel O-36, MARAD, and N42 will function as stakeholder advisors for this project. Depending on availability, the selected advisors may meet as a group when possible.

Under prior CCDoTT studies discrete event models and an economic model were developed for Pacific Coast Short Sea Shipping routes. Numerous parametric studies were also done evaluating speed, route, payload and route speed profiles to determine their impact on the principal characteristics of vessels suited for these routes. However, some of the features of the Pacific Coast routes, such as port locations and cargo types, are unique to the Pacific Coast. This project proposes to combine the efforts and lessons learned in prior studies and generalize the input data requirements to develop a “generic” model that can be applied to any route. This model will also assist owner/operators, ports and municipalities, and the Government in evaluating the viability of potential routes.

Current efforts will be to develop a rational procedure, evaluation methodology, and tool for providing guidance to the maritime community to evaluate U.S. Maritime Highways. The simulation tool/program will be verified and benchmarked against selected East Coast routes and markets. Collaboration with SNAME and the U.S. Navy’s N42 office will be established to develop a more universal industry-wide approach and acceptance of this CCDoTT product.

Project 08-6 Tasks are as follows:

- 6.1. Case Studies and Data Collection: This task will identify markets and routes to be used as case studies for demonstration of the models developed under this project, collect model input data, and document model assumptions. This task will also

include a survey of other modeling efforts that may provide insights for consideration under this project.

As part of this task, a survey of publicly available data on existing ship designs used in the European market will be collected. Where possible, the ship designers and builders who have designed and built these ships will be contacted for data. Additionally, general RO-RO ships and high-speed vessels will also be collected. The end result will be a database of ship types and characteristics that can be used as a benchmark for the results of the parametric studies.

- 6.2. Model Specifications: This task will develop a description of model input, modules, functionality, desired model output, and anticipated experiments for the in-port discrete event model, voyage analysis model, and economic model. The model specifications will be developed to maximize model flexibility and general-purpose application, and provide a means of obtaining feedback from key stakeholders. Building on the models developed under previous CCDoTT work, model fidelity and scope will be expanded to address alternative business models including container feeder services in addition to domestic RO-RO (trailer) marine highways.
- 6.3. In-Port and Voyage Analysis Models: This task will expand on previous CCDoTT work to develop one or more flexible discrete event models of in-port loading and unloading operations as well as drayage to and from shippers and receivers. The discrete event model serves as input to the voyage analysis and economic models. Under previous CCDoTT work, a voyage analysis spreadsheet model was developed. Under this current project, a discrete event voyage analysis model more tightly integrated with the in-port discrete event model will be considered. Model outputs including numbers of drayage tractors, yard tractors, terminal infrastructure requirements, voyage time, delivery times, and vessel speeds are fundamental inputs to the economic modeling effort.
- 6.4. Vessel Parametrics: This task will establish parametric relationships for domestic freight Marine Highways vessels as well as container feeder vessels for use in the modeling effort. Task 6.4 will establish payload characteristics, identify militarily useful features to be considered and their associated impacts, identify hullform and propulsion system characteristics, and establish parametrics for use with the models including both procurement and operating cost parametrics.
- 6.5. Economic Model Development: This task will develop economic models for Marine Highways including both domestic freight and container feeder services. At a minimum, the model will address the following cost elements: vessel construction and capital costs including costs of financing, vessel fuel costs, vessel manning costs, vessel food and stores, insurance costs, vessel repairs and maintenance, navigation and port charges, stevedoring and terminal costs, drayage costs, and taxes and tariffs. The purpose of the economic modeling effort is to establish a cost per trailer (or container) given market, route, terminal, and vessel characteristics. The model will be flexible and transparent, and will permit alternative business models to be considered.

- 6.6. Model Demonstration and Experiments: Under this task, the selected case studies will be evaluated utilizing the models developed, and experiments will be performed to conduct sensitivity analyses. The purpose of this task is twofold: first, to demonstrate that the models function as intended and, second, to provide insights into the selected markets and routes regarding the feasibility of Marine Highways and parameters required for success.
- 6.7. Final Report: A final report will be developed that details the technical approach and results of Task 6.1 through Task 6.6. Conclusions and recommendations will be made regarding the models developed, potential for future integration with other models or model refinement, and the feasibility of Marine Highways operations for the selected case studies.

Project 08-7: Multi-purpose American Marine Highways Series Production Ship

Research Partner: Herbert Engineering Corporation

Sub Recipient: SPAR Associates, Inc.

CSULB Co-PI: Steven Hinds

Technical Director: Rick Thorpe

Program Sector: High Speed Ship Systems

The success of an American Marine Highways (AMH) Program (Short Sea Shipping) is dependent on developing a cost effective vessel built to accommodate the requirements of Short Sea Shipping. Currently, there does not exist a well conceived and engineered AMH ship design of the right size that can serve shallow draft, less developed ports as a ship specifically developed for the American coastal trade. Therefore, it is highly desirable to develop a ship design which, by using its operational flexibility and affordable construction features, can become a standard AMH ship and accomplishing the objectives the AMH program. The intent of this new program effort is to design a simple, truck like vessel that operates at the needed speed of about 18 knots, can handle a range of cargoes, and is able to enter many ports in the USA. A ship appropriately designed may also serve in dual use capacity as an inexpensive vessel to replace ships in the aged Ready Reserve Fleet.

Additionally, it is necessary to develop a cargo handling system suitable for rapid loading and offloading of an AMH vessel. Over the years the waterborne transport of commercial general cargo freight has become highly specialized around the international freight container. Specialized vessels and large, specialized port facilities have been built to efficiently transport these containers and to rapidly load and unload them from ships. However, the infrastructure designed to handle the container is not well suited to the AMH system since the international freight container is not the preferred mode for domestic freight transport which is normally done by tractor trailers. For the AMH system to function effectively it must have an efficient port-to-ship interface that can handle effectively the three primary transport modes anticipated on the AMH: trailers, domestic intermodal containers and international freight containers (being transported from hub ports to secondary ports). One of the purposes of this project is to initiate development of freight handling systems, both on shore and on the vessel, that can minimize time in port to load and unload a vessel in AMH service

The proposed effort for this FY08 project will have two main focuses. One is to develop a cargo handling system that is both simple and inexpensive when compared to the conventional system. The second is to develop a flexible, utilitarian, easy to build AMH transport vessel. Both efforts will lead to concept level designs that identify the major characteristics of the design and describe the major features, advantages and possible disadvantages of the concept. Discussion will also be made of potential alternative designs. The technical reports developed for this project will include arrangement drawings, drawings of key features and cost estimates. These should be sufficient detail for understanding and comment by potential end-users and as foundations for future further development of these concepts.

The prospective commercial and military applications are many for this project. It can be the foundation for business plans to develop a workable AMH system on a wide variety of routes, for the development of a series shipbuilding project in support of the AMH system and be the basis for port development plans in support of the AMH system. Because the carriage of freight is a key element in military sealift capability and the use of efficient and flexible vessels suitable for smaller ports is militarily important, consideration will be included in the presentation of the concept designs as to how they can be modified to be more militarily useful to make them truly dual-use vessels.

Project 08-7 Tasks are as follows:

- 7.1. Cargo Handling System Concept Level Design: Create cargo handling systems suitable for AMH vessel. Technical approach:
 - a. Carry out literature search for available technology and previous designs.
 - b. Contact and meet with subject matter experts for their input on technology and systems available.
 - c. Develop innovative solutions for how to best load cargo on and off the AMH vessel.
 - d. A range of solutions will be developed.
 - e. Prepare a Port Terminal Design Criteria document.
- 7.2. AMH Vessel Concept Level Design: Using the input from result of Task 7.1 and initial concepts for Ro-Con vessel design, prepare a concept level design for an AMH vessel. Technical approach:
 - a. Analyze some potential routes to develop basic service parameters that the vessel should meet.
 - b. Prepare a list of basic characteristics the vessel design should meet including capacity, speed, cargo handling time, draft, maneuvering and mooring.
 - c. Utilizing existing work on international short sea shipping vessels develop the basic particulars of a suitable vessel design.
 - d. Prepare a concept design that best meets the service requirements.
 - e. Include characteristics in the design that support flexible, ease to construct and suitable for international partnering with foreign shipyards to reduce cost risk for US shipyards to lower the price. It should be suitable for dual-use application.
- 7.3. Build Strategy and Construction Cost Estimate: Develop a build strategy for construction of the ship and prepare a cost estimate. Technical approach:
 - a. Develop a build strategy for construction of the ship that focuses on making the ship easy and low cost to construct.
 - b. Prepare a cost estimate for construction in the USA.
 - c. Include international partnership and virtual shipbuilding business approaches in evaluating alternative business practices for ship construction and evaluate their impact on costs.
 - d. Review cost estimates with potential US shipyards to obtain their endorsement of the reasonableness of the cost estimates and build strategy.
- 7.4. Final Report and Presentation to Stakeholders: Prepare final report and present to Stakeholders.

Center for the Commercial Deployment of Transportation Technologies**3.0 CHRONOLOGICAL SCHEDULE OF FY08 PAYABLE MILESTONES**

Milestone/ Due Date	Document	Milestone Description	Milestone Amount
1 Month 1	Monthly Status Report	Comprehensive Monthly Status Report (Task 1.1a) including: <ul style="list-style-type: none"> • Tech. Coordination Initial Program Plan (Task 1.2a). 	\$ 81,511
2 Month 2	Monthly Status Report	Comprehensive Monthly Status Report (Task 1.1a).	\$ 159,457
3 Month 3	Quarterly Program Review 1	1 st Quarter Comprehensive Program Review (Task 1.1b) including: <ul style="list-style-type: none"> • Tech. Coordination FY08 Final Program Plan (Task 1.2b); • Sea Train Evaluation Project Plan of Action (Task 5.1), and User, Concept and Enabling Matrices Report (Task 5.2). 	\$ 157,386
4 Month 4	Monthly Status Report	Comprehensive Monthly Status Report (Task 1.1a) including: <ul style="list-style-type: none"> • Sea Train Evaluation Contender Questionnaire (Task 5.3); • AMH System Model Final Model Specification (Task 6.2). 	\$ 146,510
5 Month 5	Monthly Status Report	Comprehensive Monthly Status Report (Task 1.1a).	\$ 88,607
6 Month 6	Quarterly Program Review 2	2 nd Quarter Comprehensive Program Review (Task 1.1b) including: <ul style="list-style-type: none"> • Real Time Location System Multi Angle Sensor Demonstration Report (Task 3.1) and completion of Project 3; • AMH Production Ship Report on Cargo Handling System (Task 7.1). 	\$ 334,451
7 Month 7	Monthly Status Report	Comprehensive Monthly Status Report (Task 1.1a) including: <ul style="list-style-type: none"> • Conduct East Coast Tech. Transition Presentation (Task 2.2a); • Sea Train Evaluation Technical Attributes Reports (Task 5.4). 	\$ 115,608
8 Month 8	Monthly Status Report	Comprehensive Monthly Status Report (Task 1.1a) including: <ul style="list-style-type: none"> • Summary Report - East Coast Tech. Transition Presentation (Task 2.2b); • AMH System Model In-Port and Voyage Analysis Models Report (Task 6.3). 	\$ 101,207
9 Month 9	Quarterly Program Review 3	3 rd Quarter Comprehensive Program Review (Task 1.1b) including: <ul style="list-style-type: none"> • Sea Train Evaluation Technical Readiness Level Reports (Task 5.5); • AMH Production Ship Report on Concept Design of AMH Vessel (Task 7.2). 	\$ 170,609
10 Month 10	Monthly Status Report	Comprehensive Monthly Status Report (Task 1.1a) including: <ul style="list-style-type: none"> • Sea Train Tools Maneuvering Database and Maneuvering Characteristics of Sea Train Concepts (Task 4.2); • Sea Train Evaluation Cost Analysis Reports (Task 5.6); • AMH Production Ship Report on Build Strategy and Construction Cost Estimate (Task 7.3). 	\$ 272,485
11 Month 11	Monthly Status Report	Comprehensive Monthly Status Report (Task 1.1a) including: <ul style="list-style-type: none"> • Conduct West Coast Tech. Transition Presentation (Task 2.2c); • Sea Train Tools Seakeeping Assessment Methods for Sea Train Concepts (Task 4.3); • Sea Train Evaluation Draft Risk and Cost Reports (Task 5.7); • AMH System Model Vessel Parametrics Report (Task 6.4) and Economic Model Development Report (Task 6.5). 	\$ 318,581
12 Month 12	Quarterly Program Review 4	4 th Quarter Comprehensive Program Review (Task 1.1b) including: <ul style="list-style-type: none"> • Tech. Coordination End Year Program Plan (Task 1.2c); • Summary Report - West Coast Tech. Transition Presentation (Task 2.2d) and completion of Project 2; • Sea Train Tools Validation and Application of Maneuvering and Seakeeping Data (Task 4.4). 	\$ 139,639

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Milestone/ Due Date	Document	Milestone Description	Milestone Amount
13 Month 13	Monthly Status Report	Comprehensive Monthly Status Report (Task 1.1a) including: <ul style="list-style-type: none"> • Sea Train Tools Interim Report (Task 4.5a); • Sea Train Evaluation Final Risk and Cost Reports (Task 5.8). 	\$ 65,274
14 Month 14	Monthly Status Report	Comprehensive Monthly Status Report (Task 1.1a) including: <ul style="list-style-type: none"> • Sea Train Evaluation Best in Class Report (Task 5.9). 	\$ 69,682
15 Month 15	Monthly Status Report	Comprehensive Monthly Status Report (Task 1.1a) including: <ul style="list-style-type: none"> • Sea Train Evaluation Final Selection Report and Presentation (Task 5.10); • AMH Production Ship Final Technical Report (Task 7.4) and completion of Project 7. 	\$ 83,269
16 Month 16	Monthly Status Report	Comprehensive Monthly Status Report (Task 1.1a) including: <ul style="list-style-type: none"> • AMH System Model Demonstration & Experiments - Parametric Studies Report (Task 6.6). 	\$ 59,428
17 Month 17	Monthly Status Report	Comprehensive Monthly Status Report (Task 1.1a) including: <ul style="list-style-type: none"> • Sea Train Tools Resistance Prediction Methodology and Results (Task 4.1). 	\$ 43,944
18 Month 18	Monthly Status Report and FY08 Final Reports	Completion of all Projects including: <ul style="list-style-type: none"> • Tech Coordination Comprehensive Monthly Status Report (Task 1.1a), Comprehensive Final Summary Report (Task 1.1c) and completion of Project 1; • Sea Train Tools Final Report (Task 4.5b) and completion of Project 4. • Sea Train Evaluation Technology R&D Program Recommendations (Task 5.11) and completion of Project 5; • AMH System Model Final Report and Presentation (Task 6.7) and completion of Project 6. 	\$ 204,023
TOTAL PROPOSED AMOUNT			\$ 2,611,671

4.0 FY08 DELIVERABLES

Project No. Title	Task No Title	Deliverable	Due Date
Project 08-1. Technical Coordination and Planning	1.1 - FY08 Project Oversight	a. Monthly Status Reports	Monthly
		b. Quarterly Program Reviews	4 Quarters
		c. Final Summary Report	Month 18
	1.2 - Program Development and Planning	a. Initial Program Plan	Month 1
		b. FY08 Final Program Plan	Month 3
		c. End Year Program Plan	Month 12
Project 08-2. Technology Transition and Outreach	2.2 - Meetings, Conferences and Presentations	a. Conduct East Coast Presentation	Month 7
		b. Summary Report - East Coast Presentation	Month 8
		c. Conduct West Coast Presentation	Month 11
		d. Summary Report - West Coast Presentation	Month 12
Project 08-3. RTLS Demonstration	3.1 - Multi Angle Sensor Demonstration and Final Report	Multi Angle Sensor Demonstration Report	Month 6
Project 08-4. Computational Tools for Sea Train	4.1 - Resistance Modeling and Assessment	Sea Train Resistance Prediction Methodology and Results	Month 17
	4.2 - Maneuvering Assessment	Maneuvering Database and Maneuvering Characteristics of Sea Train Concepts	Month 10
	4.3 - Motions and Connector Loads	Seakeeping Assessment Methods for Sea Train Concepts	Month 11
	4.4 - Validations and Application	Validation and Application of Maneuvering and Seakeeping of Sea Train Data	Month 12
	4.5 - Final Report	a. Interim Report	Month 13
		b. Final Report	Month 18
Project 08-5. Sea Train Comparative Evaluation	5.1 - Prepare a Project Plan of Action	Project Plan of Action	Month 3
	5.2 - Prepare Evaluation Comparison Matrices	User, Concept and Enabling Matrices Report	Month 3
	5.3 - Prepare and Issue Questionnaires	Sea Train Contender Questionnaire	Month 4
	5.4 - Prepare Technical Attributes by Contender	Technical Attributes Reports	Month 7
	5.5 - Prepare Technical Readiness Level Analysis	Technical Readiness Level Reports	Month 9
	5.6 - Prepare Cost Analysis	Cost Analysis Reports	Month 10
	5.7 - Draft Risk and Cost Reports	Draft Risk and Cost Reports	Month 11
	5.8 - Risk and Cost Reports	Final Risk and Cost Reports	Month 13
	5.9 - Prepare Best in Class Report	Best in Class Report	Month 14
	5.10 - Prepare Final Sea Train Evaluation Report and Presentation	Final Selection Report and Presentation	Month 15
	5.11 - Sea Train R&D Program Recommendations	Sea Train Technology R&D Program Recommendations	Month 18

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Project No. Title	Task No Title	Deliverable	Due Date
Project 08-6. AMH System Evaluation Model	6.2 - Model Specification	Final Model Specification	Month 4
	6.3 - In-Port and Voyage Analysis Models	In-Port and Voyage Analysis Models Report	Month 8
	6.4 - Vessel Parametrics	Vessel Parametrics Report	Month 11
	6.5 - Economic Model Development	Economic Model Development Report	Month 11
	6.6 - Model Demonstration and Experiments	Model Demonstration & Experiments - Parametric Studies Report	Month 16
	6.7 - Final Report	Final Report and Presentation	Month 18
Project 08-7. AMH Production Ship	7.1 - Cargo Handling System Concept Level Design	Report on Cargo Handling System	Month 6
	7.2 - AMH Vessel Concept Level Design	Report on Concept Design of AMH Vessel	Month 9
	7.3 - Build Strategy and Construction Cost Estimate	Report on Build Strategy and Construction Cost Estimate	Month 10
	7.4 - Final Report and Presentation to Stakeholders	Final Technical Report	Month 15

5.0 SUMMARY AND CONCLUSIONS

The Final Program Plan is a shortened version of the full proposal submitted by CCDoTT and approved by Office of Naval Research. The plan represents the program of projects that was accepted and is currently being conducted by CCDoTT. Contained in this program are projects directed at assessing the SeaTrain concept and developing tools that can better assess the specific design characteristics of SeaTrain concept designs. The emerging influence of American Marine Highways as an approach to move cargo and reduce highway congestion and pollution is also a significant part of the final program. Substantial interest exists in the dual use approach emphasized in the projects of this program. Recent events indicate an additional multi-use potential for dual use commercial/military ships – their use in Humanitarian Assistance missions and Defense Support of Civilian Authority. This additional mission may strongly support the dual use approach to ship design.

6.0 GLOSSARY OF ACRONYMS

AMH	American Marine Highways
AP	Agile Port
CCDoTT	Center for the Commercial Deployment of Transportation Technologies
CDWG	Concept Design Working Group
CFD	Computational Fluid Dynamics
COE	College of Engineering
CSC	Computer Sciences Corporation
CSULB	California State University, Long Beach
DNV	Det Norske Veritas
DoD	Department of Defense
FEMA	Federal Emergency Management Agency
GHS	General HydroStatistics
HSS	High Speed Ship
JHSS	Joint High Speed Ship
JHSV	Joint High Speed Vessel
LOE	Level of effort
MARAD	Maritime Administration
MDO	Multidisciplinary Design and Optimization
MHC	Marine Highways Cooperative
MVS	Multi-vessel simulator
N-42	Strategic Mobility, Combat Logistics Division
NAVSEA	Naval Sea Systems Command
NSRP	National Shipbuilding Research Program
NSWC-CD	Naval Surface Warfare Center - Carderock Division
O-36 Panel	Maritime Economics
ONR	Office of Naval Research
PI	Principal Investigator
PMS385	Sealift and Auxiliary Ship Project Management Organization
POA	Plan of Action
R&D	Research and Development
RAO	Response amplitude operator
RF	Radio frequency
Ro-Con	Roll-on and Container
Ro-Ro	Roll-on/Roll-off
RRF	Ready Reserve Fleet
RSM	Response surface method
RTLS	Real Time Location System
SBIR	Small Business Innovation Research
SCS	Systematic calculation series
SES	Surface Effect Ship
SNAME	Society of Naval Architects and Marine Engineers
SSS	Short Sea Shipping
TRB	Transportation Research Board
TRL	Technical Readiness Level